CONSERVATION PLAN
LOWER YELLOWSTONE IRRIGATION PROJECT
March 2009

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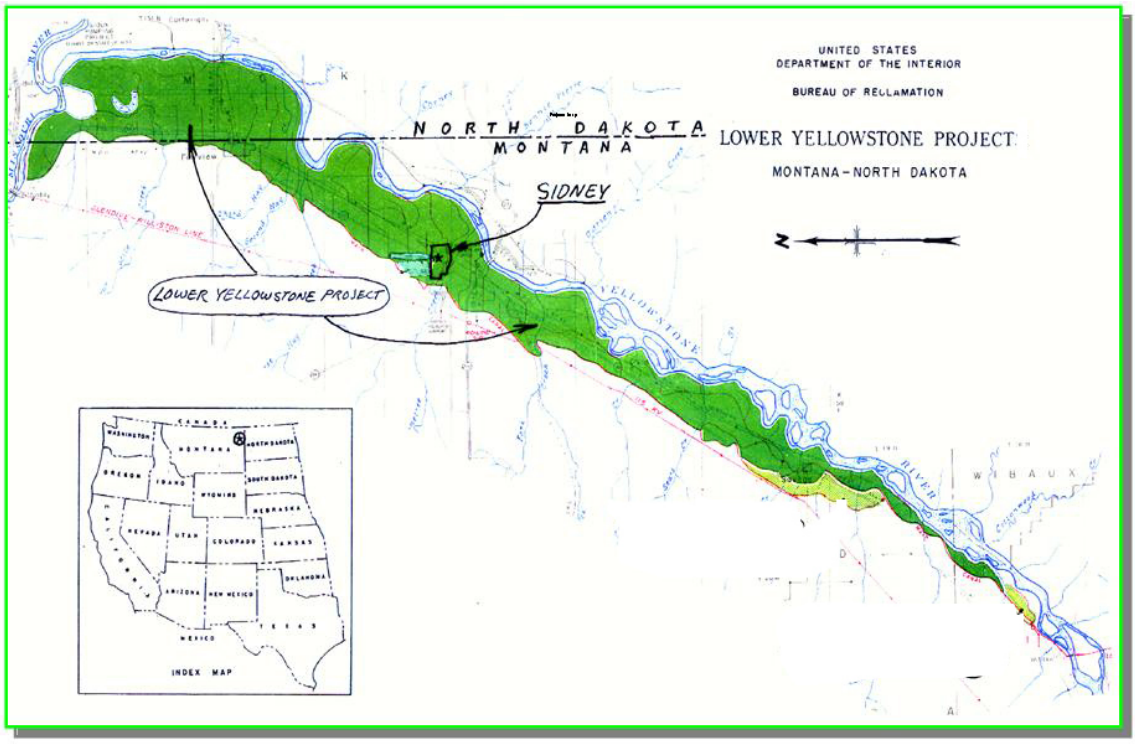
PROJECT DESCRIPTION

General

Lower Yellowstone Irrigation Project was one of the early irrigation projects built in early 1900's as part of the Department of Interior's Reclamation Era. It is located along the Yellowstone River along the border of Montana and North Dakota. It irrigates about 53,000 acres.

Surveys began in 1905, the dam and headworks were completed in 1908, and water was first delivered to the valley in 1909.

Full development of the Project was reached by 1970 and it has been constant ever since.



The facilities include the dam and diversion, 72 miles of Main Canal, 225 miles of laterals, and 110 miles of open drains. Of the 53,000 acres of irrigable land within the Project area, a small portion lies in Dawson County, Montana; about two-thirds lies in Richland County, Montana and about one-third in McKenzie County, North Dakota.

Two irrigation districts took the place of a water user association in 1926 to assume the responsibility for the operation, maintenance, and repayment of the Project. The Lower Yellowstone Irrigation District #1 was created from Montana law and the Lower Yellowstone Irrigation District #2 was created from North Dakota law. Each district is made up of 5 elected officials from within the districts' boundaries. The Lower Yellowstone Irrigation Project Board of Control was then formed by authority of Montana law for jointly managing the two districts for the sake of simplicity, efficiency, and economy.

The Board of Control secures a manager for carrying out the duties of the projects under the restraints of policy and budgets. There are 21 employees, 6 ditchriders, 5 operators, 5 canal maintenancemen, a watermaster, job foreman/assistant to manager, the manager, and 2 office personnel.

Soils

The soils of the Lower Yellowstone Project are typical of river terraced or river bottomlands modified somewhat by alluvial outwash from the adjacent rolling plains. The soil is alluvial with silt loams and clay loams predominating. Sandy soils are present on terraces and heavy clays are present in old oxbows caused by the meander of the Yellowstone River. The soils within the irrigated areas are very productive. Vertical permeability is sufficient to maintain satisfactory salt balance in the plant root zone. The drainage of the lands is favorable.

Climate

The elevation of district land varies from 1980.5' at the Intake Diversion Dam, to 1860' at the terminal end of the Main Canal. Current climatic conditions are described as semi-arid and continental with cold winters, warm summers and low annual precipitation. The annual rainfall in the Yellowstone Valley is 14.3" per year, and snowfall averages 30.0" to 37.0 per year.

The temperatures in the region exhibit a wide rage of variance, with average daytime temperatures of 86°, with 7.3° average daytime temperature for December, January, and February. The coldest temperature was -47°, January 10, 1912. The hottest temperature was 110°, July 27, 1917.

The average frost-free days is: 125 days.

Crops

There is some degree of diversity of crops. Sugar beets have been the main crop until just recently. Current commodity prices and high input costs are changing the pattern somewhat. The figures in the table below are based on the crop census taken by the project in 2007.

Crop Census 2007

Crops	Acres	Percentage
Sugar Beets	21994	41.79
Wheat	8868	16.85
Malt Barley	5568	10.58
Hay & Alfalfa	9489	18.03
Corn	4747	9.02
Other	1963	3.73
Total	**52629**	**100**

Environmental Issue

A fish species, the pallid sturgeon, present in the Missouri River system, was listed as endangered in 1990. A recovery program is ongoing and includes attempts to regenerate the species by using the Yellowstone River. It has been found that the Project's low-head dam is impeding fish passage to desired spawning areas. Entrainment of the fish in the Project's Main Canal is also a concern. The Bureau of Reclamation and other federal agencies are currently formulating a plan to correct these concerns. A rock ramp to replace the dam, and headworks fish screens are likely to be installed.

INVENTORY OF WATER RESOURCES

On October 30, 1905, the United States of America acquired an appropriated right to 1000 cubic feet per second for the purpose of irrigating the Lower Yellowstone Irrigation Project. Another right of 300 cfs was appropriated in 1939 for a total of 1,300 cfs. There are no storage facilities for the project and water availability is entirely dependent on the run of the river. There has been no time in the 100-year history of the Project when water was not available in the Yellowstone River and divertible into the Main Canal.

The lower Yellowstone Project requires no storage. The water supply is diverted directly from the Yellowstone River by means of a low-head diversion dam called Intake Diversion Dam located eighteen miles downstream or northeast of Glendive, Montana.

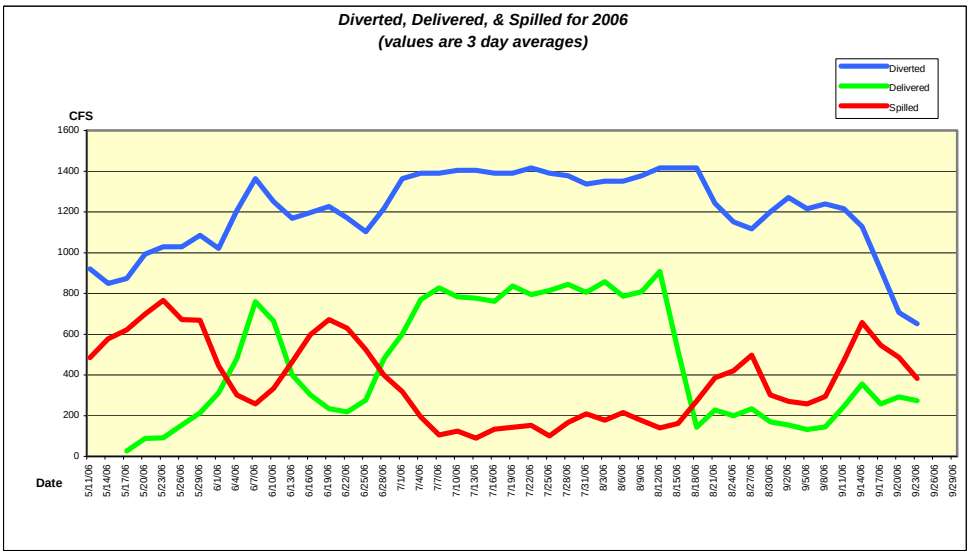
The facilities include the dam and diversion, 72 miles of Main Canal, 225 miles of laterals, and 110 miles of open drains. There are 910 farmunits and about 2,300 farm delivery points. Of the 53,000 acres of irrigable land within the Project area, a small portion lies in Dawson County, Montana; about two-thirds lies in Richland County, Montana and about one-third in McKenzie County, North Dakota.

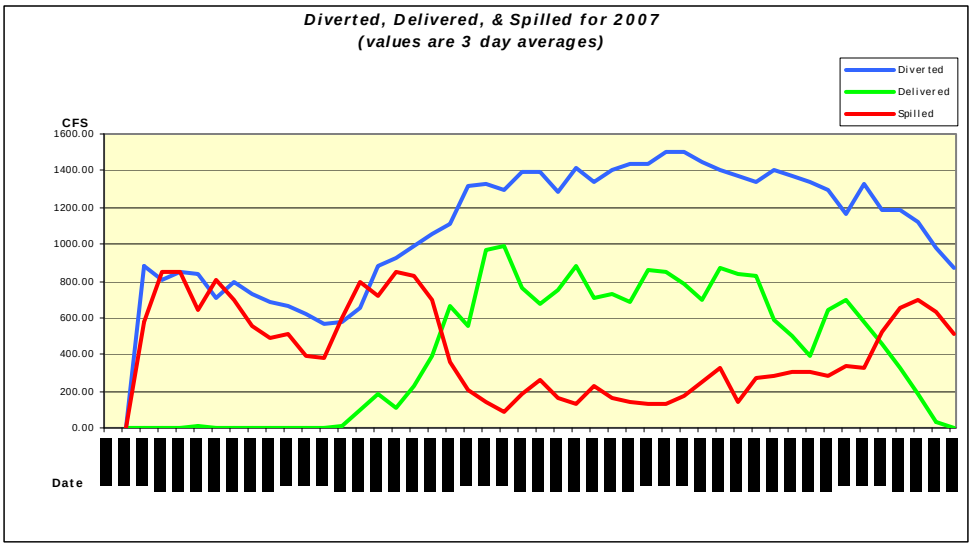
All of the Main Canal is unlined. The lateral system is unlined except for about 10 miles, less than 5 % that is enclosed in pipe.

CURRENT WATER BUDGET

The Project currently takes daily readings of the Main Canal diversions and 18 strategic locations on the Main Canal. Readings are also estimated once daily on all Main Canal and lateral spills. All diversions and deliveries are tabulated every day for the watermaster. Pump flows are also recorded on a daily basis. All farm deliveries are measured or estimated and recorded each day to maintain records for each farmunit.

The Project water hydrographs are very typical of large projects with open unlined conveyance systems. Graphs of water diverted, delivered and spilled are illustrated below. There has been no attempt to compute the evaporation and transportation losses due to the complexity of doing so and the intricate measuring system that is required.





The delivery efficiency is considered to be the ratio of amount delivered to amount diverted. The maximum peak efficiency occurs during high demand periods and is consistent with what is generally obtainable with open-unlined distribution systems. However, the total season efficiency is quite low. See the discussion on water management below. The peak and season efficiencies for 2005,2006, and 2007 are as follows:

Year	Diverted	Delivered	Peak Efficiency	Season Efficiency
2005	327,850	120,723	62%	37%
2006	329,236	119,057	64%	36%
2007	304,700	116,302	62%	38%

Delivery Efficiencies

CURRENT WATER MANAGEMENT

The water season is normally from May 1 to October 1. There are 6 ditchrider divisions. The ditchrider takes water orders from the wateruser, tabulates them and passes them on to the watermaster. A water policy requires that orders be received by noon on the previous day of need. The watermaster apportions the water amongst the ditchrider divisions according to the tabulated ditchrider need and water availability.

The project has a unique system in that water demands are not directly satisfied from the diversion dam. The project is very long and narrow with the greater part of the acreage located along the lower reaches of the 72-mile carriage system. There are 8 major drainages that cross the project where water can be diverted back to the river. Water orders can be filled from water being spilled from 3 of these drainages. The Burns Creek and Savage Spillways are located at 8.5 and 17.5 miles from Diversion. The 1st Hay Creek Spillway is located near mile 51. Water available from completing irrigation events can be spilled at these points and is available for future demand. This procedure allows water orders to be filled within 24 hours instead of the 48 or more that would be required under the more conventional management method.

The distribution system is capable of delivering about 2.8 cfs per 160 acres during periods of the highest demand. (The project manages deliveries based on wateruser acreage divided by 160 acres). The demand exceeds the distribution system's capability in most years for a 7-12 day period depending on cropping patterns and precipitation. Demand can get as high as 4 cfs per 160 acres.

Controlled deliveries or water rationing occurs when demand exceeds distribution capability. The watermaster determines the extent of rationing and the ditchriders administer it according to tabulated acreage per wateruser.

A full water accountability system is used. All diversions, deliveries, supplemental pump inflow, and spills are monitored daily and recorded. The recordings are estimated for sites without measuring devices. All farm deliveries per farmunit are entered into a central database.

The Project maintains water distribution policies for fair distribution, prudent on-farm water use, water ordering procedures, record keeping, and an itinerary for water rationing.

WATER MANAGEMENT ISSUES AND GOALS

1. Wateruser demand exceeds conveyance capability for 7-12 days each year.

2. Not all laterals, sublaterals, farm deliveries are measurable due to lack of measuring devices and essentially no measuring devices exist on lateral spills, all leading to misappropriation of water or excess water at times.

3. Inadequate water level control structures exist in the Main Canal to serve deliveries from the Main Canal and some of the laterals under changing and low wateruser demand periods. Installation of Main Canal Control Devices is an ongoing measure and is part of the Project's rehabilitation program. The goal is to install a device each year depending on availability of funds. Accelerating this program is important because the benefits can only be achieved if the water surface is achieved on the entire Main Canal system. Procurement of Government assistance is needed to complete this important job. The goal is to complete this program in 4 years

4. Fluctuations in water surfaces occur especially on long lateral systems causing over-checking and loss of water. Control water surface devices, better administrative effort, and adherence to policies would help this situation.

5. Open unlined lateral systems; many on meandering contours do not promote on-farm water conservation practices. Relocating and closing laterals in pipe is needed to complement the accelerating conversion of flood irrigation practices to sprinkler irrigation. Lower Yellowstone Irrigation Project does not have financial resources to pipe the larger lateral systems envisioned in this measure. The goal is to secure grants and cost-share programs from federal and state funding avenues and accomplish the measure in a 10-year period. It is envisioned to accomplish this measure in a number of phases beginning with the higher priority.

WATER MANAGEMENT MEASURES

Measure #1 – Lessen Water Rationings
This conservation issue can be alleviated with execution of the other 4.

Measure #2 – Install Measuring Devices

Better service to waterusers could be improved by completing measurement systems. About 50 lateral and sublateral turnouts are in need of measuring devices. There are 3 of 5 of the Main Canal spills into main drainages measured. No measuring devices exist on the 68 lateral spill locations. Approximately 30% of the 2300 farm deliveries are in need of accommodations for measuring water. Installation of measuring devices is an ongoing measure and is part of the annual budget. Many have been installed, but many are left. Procurement of funds is necessary to accelerate this program. The goal is to achieve full measurement facilities in 10 years.

Measure #3 – Install Main Canal Control Structures

Insufficient water control exists throughout the Main Canal to provide deliveries to laterals and to farmunits directly from the Main Canal under low flow conditions. A study was completed in 2007 that identified 9 automated canal checks needed to accommodate critical areas, 4 have been installed.

Typical Main Canal Automated Check

The average annual diversion of water for the Lower Yellowstone Irrigation Project is about 350,000 acre-feet. Delivery efficiencies can be as low as 5%-10% for at least 20% of the season, mostly due to the inability to draw water from the uncontrolled Main Canal water surface. A 10% reduction in diversion or 35,000 acre-feet is expected with this measure.

Measure #4 – Controlling Water Surface Fluctuations

Conservation issue #4 can be reduced with completion of item #3. This issue is also an administrative problem that can be reduced by improving ditchrider water operations techniques and adherence to policies on water delivery changes and check structure adjustments.

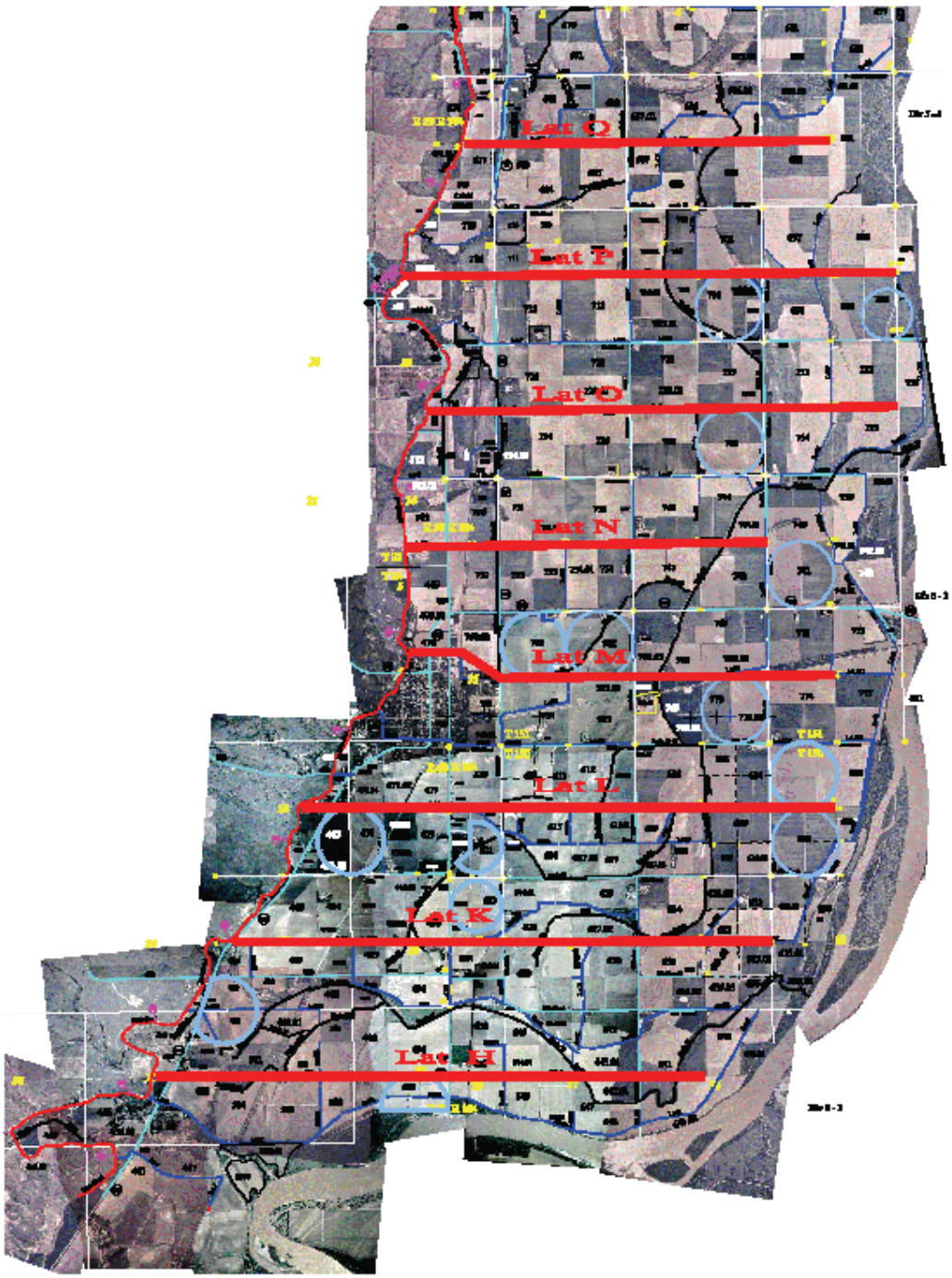
Measure #5 – Piped Laterals

This measure involves piping laterals to accommodate sprinkler irrigation. Essentially all lands were flood irrigated until 2005. Labor problems and spring droughts persisted in recent years and cost-share programs sponsored by the Natural Resources and Conservation, Department of Agriculture became more available to waterusers. Conversion of flood irrigation and to sprinkler irrigation has bloomed and 32 pivots have been installed in the last 4 years. About 9% of the Project acres are involved in sprinkler irrigation.

An excellent water conservation measure can be the conversion of open-unlined lateral systems to closed pipe systems. Many laterals experience losses of 10%-35% due to evaporation, consumptive use of bank vegetation, and seepage. An additional 15% is generally lost in end spillage. Closed systems eliminate these losses.

There are numerous lateral systems that could be rehabilitated to accommodate sprinkler irrigation. There are 13 laterals below Main Canal mile 53 where 43% of the Project acres lie. These lateral systems provide service to an area where land is well adapted to center pivot irrigation and where sprinkler development is most likely to occur. See the map below that illustrates the largest portion of the lands below mile 53.

There is an urgency to initiate the closing of lateral systems. On farm funding for conservation efforts is increasingly available and piping laterals will encourage waterusers to apply. This measure is undoubtedly of highest priority from a conservation standpoint.



TECHNICAL EVALUATION

Technical evaluation is provided on 3 of the 5 measures:

Measure #2 - Install measuring devices

The 19 lateral turnouts at the Main Canal vary in size. About 50% will accommodate cipolletti weirs and the remainder would be parshall flumes. They range in size from 10 cfs to 85 cfs. The average cost of lateral turnouts is $600 for a total of $114,000

The 31 sublateral turnout measuring devices range in size from 10 cfs to 35 cfs. Both weirs and flumes are the preferred devices. The average cost of these devices is $3,500 for a total of $108,500.

The two measuring devices at Four Mile and Ferry Coulee spillway sites should be incorporated into controlled water level devices. All other spillway sites are currently set up in this fashion. Overshot gates are used that are calibrated successfully for measuring devices. The cost of these devices would be approximately $120,000.

The cipolletti weir would be the desired measuring devices for the 68 spill sites into Project drains. They would range in size from 3 cfs to 35 cfs. Average cost for these structures would be $3,800 for a total of $258,400.

Total cost for measuring devices is $600,900.

Measure #3 – Install Main Canal Control Devices

It is important to install automated check structures in the 72-mile long Main Canal so that water is moved through the system in a timely manner. The irrigation district has standardized these structures. Purchased gate hardware complete with the automated control systems are placed and secured in concrete structures. Structures vary in size from single bay 20-foot openings to double bay with 16-foot openings. The average structure is made up of 45 cubic yards of concrete. Average cost of the structure is $28,000 including excavation, concrete, steel, forming, decks, backfill, and rock protection. The average cost for gates and controllers has been $88,000. Total estimated cost of the remaining checks is $580,000.

Measure #5 – Piped Laterals

Installing pipe laterals involves right-of-way purchases, engineering services, and a construction program. LYIP can provide all services to accomplish this task if it is performed in phases. A study and estimate was done on laterals in the Fairview to the confluence region. The study and estimate included lands served by Laterals H, K, L, M, N, O, P, and Q, R, S, T, U, and V. The area serves 22,630 acres. The cost of this measure is $14,658,000. A summary tabulation of the laterals below mile 53 is illustrated below.

Piped Laterals H,K,L, M,N,O,P, and Q, R,S,T,U, and V

Pipe Tabulation - 3 cfs
/ 160 acres

Lat	42	36	30	27	24	21
H	7,800	2,640	2,640	2,640	2,640	2,640
K	7,800	2,640	2,640	2,640	2,640	2,640
L	7,800	2,640	2,640	2,640	2,640	2,640
M	3,830	2,640	2,640	2,640	2,640	2,640
N	3,430	2,640	2,640	2,640	2,640	2,640
O	2,660	2,640	2,640	2,640	2,640	2,640
P	3,300	2,640	2,640	2,640	2,640	2,640
Q	1,716	2,640	2,640	2,640	2,640	2,640
R	1,716	2,640	2,640	2,640	2,640	2,640
S	2,640	2,640	2,640	2,640	2,640	2,640
T				1,320	2,640	2,640
U					2,640	2,640
V						2,640
	42,692	26,400	26,400	27,720	31,680	34,320
Unit cost	$65.00	$50.00	$40.00	$32.00	$23.75	$19.50
Cost	$2,774,980	$1,320,000	$1,056,000	$887,040	$752,400	$669,240

Total	**$7,459,660**
Total L	189,212
	35.85 miles

Estimated Cost - Piped Laterals

1-Mar-09

ROW Acquisition	66	ac	$2,000	$132,000
Pipe	LS	LS	LS	$7,459,660
Pipe Installation	189,212	ft	$6	$1,135,272
Pipe Delivery Points	72	ea	$20,000	$1,440,000
Screening Devices	13	ea	$20,000	$260,000
Measuring Devices	13	ea	$15,000	$195,000
Total Field Cost				$10,621,932
Engineering and Overhead	0.15		15%	$1,593,290
Subtotal				$12,215,222
Contingency	.		20%	$2,443,044
TOTAL ESTIMATED COST				**$14,658,266**

WATER SAVINGS

Measure #1 – Lessen Water Rationings
No water savings expected.

Measure #2 – Install Measuring Devices
A reduction of 3% of diverted water can be expected. This amounts to 10,500 acre-feet annually.

Measure #3 – Install Main Canal Control Structures
An analysis was done in 2004 and the expected amount saved was 25,000 acre-feet annually.

Measure #4 – Controlling Water Surface Fluctuations
Over-checking exacerbates seepage on about one-fourth or 56 miles of lateral systems. An average seepage loss can be 2 cubic feet /sqaure feet / day or a computed 2% of diverted water. This amounts to about 20 cfs or about 5,000 acre-feet for the 4.5-month season.

Measure #5 – Piped Laterals
The average amount diverted into divisions 5 & 6 is 120,000 acre-feet or 5.3 af/acre. The average amount delivered is 56,500 af or 2.5 af/acre. Sprinkler irrigation will reduce the delivery volume to about 1.75 ac-ft/acre. The diversion into the area could be held to 30% above delivered amounts. A comparison water budget is illustrated in the table below:

Current conditions	Currently	Piped Laterals
Diverted to area	5.3 acre-feet	2.5 acre-feet
Delivered to farms	2.5 ace-feet	1.75 acre-feet
Water use	119,800 acre-feet	56,500 acre-feet

SUMMARY SCHEDULE AND COST

Conservation Measure	Water Savings	Schedule	Cost
1. Alleviate Water Rationing	None Expected	10 years	Not Itemized
2. Install Measuring Devices	10,500 acre-feet	10 years	$600,000
3. MC Water Control Devices	25,000 acre-feet	4 years	$580,000

4. Fluctuating Water Services	5,000 acre-feet	10 years	Not Itemized
5. Piped Laterals	63,300 acre-feet	Dependent on Availability of Funds – 12 years	$14,658,000

MONITORING

A monitoring program is essential to determine the effectiveness of new programs. It also helps identify future management improvements. Monitoring efforts include:

- Continued water measurement as done previously.
- Collect data on all new measurement device readings.
- Comparison of progressive hydrographic data before, during, and after program implementation.
- Compare irrigation drainage volumes before, during, and after program implementation.

ENVIRONMENTAL REVIEW

A preliminary review identifies probable desirable effects of implementing the measures listed above.

- Improve in-stream flows
- Less non-point source and point source irrigation drainage